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GoddardView

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Rain, Rain, Don't Go Away

Taking a 360-Degree View of Water

The Science of Photography

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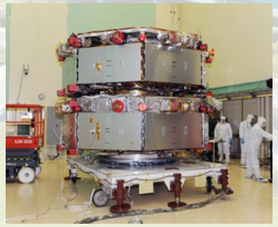
GoddardView

THE WEEKLY

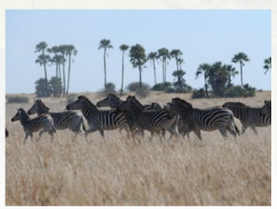
Happy Birthday, Curiosity!
NASA's Curiosity rover celebrated its Martian birthday on August 5, the day that it landed on Mars. In honor of the occasion, engineers at Goddard Space Flight Center are using the Sample Analysis at Mars instrument to "sing" Happy Birthday to Curiosity. Watch the video by clicking on the picture.

MMS Stacked for Shock Tests
Spacecraft must go through a series of rigorous tests before they are launched into space. NASA's Magnetospheric Multiscale mission is undergoing those tests now. The testing schedule is all the more complicated as the mission consists of four identical observatories. For more, click on the photo.



New NASA Mission to Help Us Learn How to Mine Asteroids
Asteroids could one day be a vast new source of scarce material if the financial and technological obstacles can be overcome. Critical experience will be gained with NASA's asteroid sample return mission, OSIRIS-REx. To explore this new mission, click on the image.

NASA Satellites Used to Predict Zebra Migrations
One of the world's longest migrations of zebras occurs in the African nation of Botswana, but predicting when and where zebras will move has not been possible until now. To discover how NASA is making this happen, click on the picture.



On the cover: The NASA Polarimetric Radar (right) and Dual-Frequency, Dual-Polarimetric Doppler Radar (left) set up in field near Traer, Iowa. Photo credit: NASA

GoddardView

Goddard View is an official publication of NASA's Goddard Space Flight Center. Goddard View showcases people and achievements in the Goddard community that support Goddard's mission to explore, discover, and understand our dynamic universe. Goddard View is published weekly by the Office of Communications.

News items for publication in *Goddard View* must be received by noon Wednesday of each week. You may submit contributions to the editor via e-mail at john.m.putman@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

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NOBEL LAUREATE SHARES INSIGHTS WITH GODDARD'S FUTURE SCIENTISTS

By: Sawyer Rosenstein

What do you do after winning the Nobel Prize in physics? For John Mather, it wasn't calling it quits and retiring. Instead, Mather is working on the follow-up to the Hubble Space Telescope as well as educating the interns who may one day be following in his footsteps.

The Nobel laureate answered a variety of science questions from summer interns at NASA's Goddard Space Flight Center in Greenbelt, Md., on July 11. Topics covered the sun, dark matter and even extraterrestrial life. The standing-room-only audience heard about Mather's work studying cosmic microwave background radiation, which earned him the Nobel Prize in 2006. He also focused on his work with the James Webb Space Telescope, for which he currently is the senior project scientist.

However, Mather's main goal was not just to answer the interns' questions, but also to inspire them to answer the questions he could not. "These interns will come back and be next year's geniuses that do something really revolutionary," Mather said.

Mather said that the timing would allow this year's interns a chance to make full use of his current work with the Webb telescope. "For a person in college, if they go to graduate school now, they'll be working with the data when they come out," Mather said.

He said that's part of the reason why he makes the effort to not only do general public outreach, but specifically to Goddard interns. "I want the future astronomers that are going to be using [the telescope] to be ready, so they have to already be thinking about what they're going to be using it for," Mather said.

Mather helps to support Goddard interns with the John Mather Nobel Scholarships, which he created using some of the Nobel Prize money he won. The scholarship allows interns who are interested in the work being done at NASA and Goddard a chance to show off their work and help them prepare for future employment with a $3,000 grant. Past winners have used the prize to visit graduate schools, help with research and even cover their travel so they can present their own scientific papers.

For Mather, the Nobel Prize is in the past, and he continues to look forward to the work of today and the scientists of tomorrow.

"I think what I'm doing now is the most interesting and important thing I could be doing," Mather said. "We never know what the future will bring, but these interns are one way to make it happen." ■

Above: Nobel laureate and James Webb Space Telescope Project Scientist John Mather gave a standing-room-only presentation at NASA's Goddard Space Flight Center in Greenbelt, Md., on July 11. Photo credit: NASA/Goddard/Pat Izzo

UP, UP AND AWAY: GODDARD INTERNS WORK ON BALLOON-BASED TELESCOPE

By: Talya Lerner

Dr. Rinehart is hoping to change the way scientists study the stars. To do this, he needs a group of interns…and one very large balloon.

From a pool of 300 applicants came a group of seven summer interns to work with Dr. Stephen Rinehart, associate chief of the Observational Cosmology Laboratory at NASA’s Goddard Space Flight Center in Greenbelt, Md. The seven students are contributing their expertise to an intern project called BETTII, short for Balloon Experimental Twin Telescope for Infrared Interferometry.

Designed to study stellar evolution, the BETTII mission is a large project with a host of individual well-defined subsystems, which makes it ideal for division among interns. “We can find individual projects that can be done in the course of an internship,” Rinehart said. The students can look back at the summer and say, “I built that,” he said.

Spencer Gore, Arpan Rau, Stephen Weinreich, Deborah Andrade, Sophie Johnson-Shapoval, Marcelo Canaparro and John Alcorn are working with Rinehart, as well as individual mentors, to make sure BETTII is ready for its 2015 launch date.

Earth’s atmosphere poses problems for astronomers using ground-based infrared telescopes. From the ground, an observer would not be able to see through the atmosphere because it is opaque at these wavelengths. At higher altitudes, however, seeing beyond the atmosphere is possible.

Astronomers want to make observations in infrared light because it can cut through interstellar dust and provide some of the best views of star formation. The best place for an infrared telescope would be in space, above the distortions Earth’s atmosphere causes. Sending a big telescope to space, however, would be expensive and challenging. With that in mind, Rinehart thought of a more cost-effective idea, to try using interferometry. Interferometry is a method in which the observations of smaller telescopes are combined, effectively providing the viewing power of a larger one.

“BETTII was conceived to prove that putting an interferometer in space would work,” Rinehart said. The whole machine will be 30 feet long, 6 feet across and 8 feet high. The two telescopes, however, will each be less than 2 feet wide. Without interferometry, a single telescope would need to be about 65 feet in diameter, which would weigh more than 1,000 pounds.

Scientists at Goddard will send BETTI up on a balloon above 99.5 percent of the atmosphere. “The heavier the payload, the bigger balloon you need,” Rinehart said. For BETTII, Rinehart hopes to use a balloon that is about 250 feet tall, and 290 feet in diameter. On the balloon, BETTI will sway like a pendulum, and the remaining atmosphere will still be able to distort observations. This year’s interns are set to work on BETTII’s control system, which will offset these movements and make the twin telescopes as precise as possible.

BETTII will allow scientists to look through the interstellar dust clouds and study coevolution, the science behind how stars evolve in proximity to one another. “It is a really unique way to study the earliest stages of star formation,” Rinehart said.

Arpan Rau, who attends Naperville North High School near Chicago, is the only BETTII intern in high school. Rau said he benefits from the fact that he is getting the chance to learn a lot that he hasn’t yet studied. “I can’t go 10 minutes here without learning something new or having my mind blown by one of the other interns,” he said. “It’s definitely an experience.”

Rinehart set up the program so that at first the interns are working individually. As the internship progresses, the projects will soon piece together and become a group effort.

“Everyone is working on very specific tasks but overall it is the same project,” said John Alcorn, from the University of Alabama in Huntsville. “It is great to be part of the whole thing while you’re still doing your own specific set of tasks and problems.”

Spencer Gore, from the University of Illinois at Urbana-Champagne, is a returning BETTII intern. Gore said he came back to work on this project because he is really invested in the goal of the mission. “Dr. Rinehart and the other mentors play a very important role in my life,” he said. “They are, in many ways, an extension of my family and friends because I know that they feel invested in my success as much as I feel invested in the success of their project.”

The seven students are working to piece together the BETTII puzzle, drawing on the notes, resources, technology and programming from previous interns. The progress they make this summer will help the next teams succeed as well. In the end, each intern is contributing to BETTII’s development and helping the world learn that much more about the formation of the stars. ■

Opposite: Stephen Weinreich, a Goddard intern who attends Brown University, works on BETTII’s power distribution electronics. Photo credit: NASA/Goddard/Talya Lerner

GPM COMPLETES SUCCESSFUL IOWA FLOOD STUDIES FIELD CAMPAIGN

By: Ellen Gray

On a Wednesday afternoon in June, a severe storm outbreak spawned huge thunderstorms across Iowa and western Illinois. NASA's Polarimetric precipitation radar was in place to scan the storms as they swept through the region.

"It's unbelievable out here," Walt Petersen of NASA's Wallops Flight Facility wrote in an email dispatch from Traer, Iowa. There, two NASA radars were stationed as part of the Iowa Flood Studies field campaign, which Petersen led, for the Global Precipitation Measurement mission.

"We caught a tornado outbreak," he said. "They are just marching by us, coming in about 30 to 50 kilometers away."

The Polarimetric, or NPOL, radar observed a number of distinctive hook features in many of the supercells, one only 25 miles to the north of the radars. The curved "hook" in storm clouds is produced by rain, hail or debris wrapped into the spinning center of the storm—a classic indicator for potential tornado production. In fact, tornadoes were spotted in and near several Iowa towns to the northwest of the radars.

"We had an extremely busy campaign," said Witek Krajewski, director of the Iowa Flood Center at the University of Iowa in Iowa City that partnered with NASA's GPM mission to run the Iowa Flood Studies, or IFloodS, experiment from May 1 to June 15. This year, it was a drastic change from the severe drought conditions of 2012. Rain showered eastern Iowa nearly every day, Krajewski said.

IFloodS was a ground validation field campaign designed to provide ground truth and interpret satellite measurements. "A lot of what we're trying to achieve here in IFloodS is to connect everything we see from space to what we see in the atmosphere and at the ground," Petersen said. IFloodS' goals were to evaluate satellite estimates of rainfall and see how those estimates help predict flooding of Iowa's rivers.

Many current weather and research satellites have instruments that see rain from orbit. In 2014, NASA and the Japan Aerospace and Exploration Agency will launch GPM's Core Observatory, which will be able to observe more detail and a broader range of precipitation types. One instrument will be able to better distinguish snow and ice from liquid rain, and its spaceborne radar will generate 3-D images of clouds and the precipitation inside.

It's a smorgasbord of satellite data that scientists need to interpret before they can put it to use in forecasting floods.

During this IFloods experiment, NASA and the Iowa Flood Center set up hundreds of rain gauges, soil moisture sensors, weather radars including NPOL, and other instrumentation to measure rainfall as accurately as possible across eastern Iowa. They then compared the ground measurements to observations made by satellites passing overhead.

The campaign began with a slushy surprise. "We came out to sample rain and we started out with a historic snowstorm," Petersen said. The May snow, the last gasp of a long winter, gave them a good case study for how snow and rain mix in a complex event. But soon the spring weather turned into just what they needed, a raining parade showing off everything from light drizzle to the fat drops from rolling thunderstorms.

The network of ground instruments and the advanced NASA weather radars took a very detailed look at the entire precipitation process, from ice particles at the top of a cloud melting into rain drops as they move to the bottom of the cloud and then sprinkle to the ground and into rain gauges. By understanding the details of the precipitation process in the field, the science team can fine-tune their methods to turn satellite observations into good rainfall measurements.

With six weeks of accumulated data, analyzing it all in detail will keep Petersen, Krajewski and their colleagues busy for the next year. From a first look at the data, "The results from the ground instruments and the orbiting satellites seem broadly consistent, but there are clearly some areas where we need to improve our understanding of what's going on," Petersen said.

Once scientists have good rainfall measurements, weather forecasters and others can use it. But the applications of the data go far beyond predicting the weather. NASA chose Iowa for its study site because of the presence of the Iowa Flood Center, its established network of monitoring instruments and its expertise in studying and predicting floods.

For floods, "large amounts of rainfall are a necessary ingredient," said Krajewski. During IFLoodS, large amounts of rainfall made an appearance, swelling rivers and causing flooding across the state. To forecast these damaging events, scientists also must understand factors including how the water moves through the soil and over the terrain as it makes its way into the river system. "It's a complicated phenomena and you have to have a good handle on these conditions to be able to make a good prediction."

Those conditions are loaded into computer models that simulate water movements, including whether it may inundate cities and towns. Good flood predictions are essential for warning systems and decision-makers. "Among the weather disasters in the U.S., flooding is second only to heat in the number of deaths, and it is number one in the dollar amount of damages," said Pedro Restrepo, hydrologist-in-charge of the National Weather Service's North Central River Forecast Center. In 2008, for example, flooding in the Midwest caused more than $10 billion in damages.

Worldwide, countries without weather radar or rain gauge networks are at even more of a disadvantage because they do not have strong warning systems. That's why the GPM mission, with its precipitation observations covering 90 percent of the globe every three hours, is so important, Petersen said. The GPM Core satellite and its partner satellites can fill in the gaps in the ground network—in part, thanks to the work of the IFloodS team.

After a busy spring, Restrepo at the National Weather Service is looking forward to testing IFloodS data in their flood forecast models over the coming months. "Having the opportunity to participate in this experiment, and eventually having the opportunity to have the information from the satellite based GPM, will give us a considerable advantage for improving river flood forecasting." ■

Above: A cluster of rain gauges and soil moisture sensors deployed in Iowa during the IFloodS campaign. Photo credit: Iowa Flood Center

Escaping from the ocean, then surfing on clouds until taking that fateful fall back to Earth, water is on a journey. NASA's new short film "Water Falls" invites the public along for the ride as scientists follow water around the globe—on a globe.

Produced specifically for the Science on a Sphere media platform in partnership with the Global Precipitation Measurement mission, "Water Falls" tells the story of the movement of water throughout the planet on a spherical screen—literally giving a 360-degree view of water. The film introduces viewers to the water cycle. It shows how water in the atmosphere regulates climate, the global and local consequences of too much or too little rain, water's effect on society from food production to urban sustainability, and the role of water in dangerous storms and hurricanes.

"Scientists need to know how much it rains and snows globally to better understand a range of applications from natural disasters to crop modeling and weather prediction," said Dalia Kirschbaum, GPM applications scientist and education and public outreach coordinator at NASA's Goddard Space Flight Center in Greenbelt, Md.

The GPM mission is an international satellite mission led by NASA and the Japan Aerospace Exploration Agency to measure when, where and how much it rains or snows around the world every three hours. The GPM Core Observatory is set to launch in early 2014.

That global perspective is reflected in "Water Falls" as it plays on a globe-like screen. Science on a Sphere technology consists of a 50-pound hollow sphere made from carbon fiber, the same material used to make standard theatrical movie screens. About 6 feet in diameter, the screen hangs at eye level and is suspended from the ceiling by three carbon fiber cables. Four projectors surround the sphere, each covering a 90-degree section of the screen that together display seamless, fully spherical images for depicting animations, visualizations or live-action video.

The film is at the intersection of art and science. It combines visualizations of real data, abstract animations to illustrate science concepts, and live action photography—all using the latest techniques for filming on the technically challenging sphere. But Michael Starobin, the film's producer, is particularly excited about the story line of "Water Falls."

"While I spend a lot of my time thinking about the technology, the most important part is always the story," Starobin said, who worked with GPM scientists and education and outreach staff to write the script. "Both the satellite mission and the water cycle that it will study describe intricate webs of moving parts, and the film presents these complex interworkings in artistic and approachable ways."

The 9-minute film will premiere at the Space Foundation Discovery Center in Colorado Springs, Colo., on Oct. 10 and at The W!LD Center in Tupper Lake, N.Y., on Oct. 12. The film will then be released worldwide to the other 100 Science on a Sphere platforms around the world on Oct. 23, when the film will debut at Goddard's Visitor Center. A portion of the film's spherical animations will also be adapted for a 2-D viewing screen and developed into short videos to further explore some of the science concepts discussed in the film.

In addition to the film, "Water Falls" will have accompanying educational notes and playlists for docents. These will include a selection of animations from the film as well as other data visualizations from GPM, the Tropical Rainfall Measuring Mission and other NASA satellite missions, which will be made available to all Science on a Sphere venues. Several lesson plans designed for teachers to use before and after viewing the film will also be available, as well as independent lessons and activities for teachers to conduct in their classrooms with accompanying short videos.

"'Water Falls' underscores how important it is to have accurate precipitation measurements to understand our planet," Kirschbaum said. "Rain or snow, or both, affect everyone on the planet in some way every day. With a better understanding of the science, the GPM mission can help a lot of people around the world." ■

Above: For behind-the-scenes photos of the "Water Falls" production and accompanying educational materials, click on the image.

TAKING A 360-DEGREE VIEW OF WATER

By: Kasha Patel

Through the eyes of a teacher, seeing a star pupil go on to inspire other students through teaching is a source of joy and pride.

This is the case for Peggy Foletta, who recently retired after chairing the science department at Kingsburg High School in Fresno County, Calif., for 28 years and handed off the teaching reins of the program to an instructor who was one of her brightest students.

During her 37-year tenure as a teacher, Foletta stumbled upon a NASA educational program, which she thought could make a positive impact on her students' learning process. In 1995, Foletta brought the Global Learning and Observations to Benefit the Environment, GLOBE for short, program to Kingsburg.

GLOBE is a worldwide, hands-on science and education program. During the week of Aug. 12–16, more than 250 teachers and students from more than 25 countries will gather in Hyattsville, Md., to share their experiences implementing GLOBE in their schools and to plan collaborative projects in the coming year. The students also will showcase their research projects. The teachers and students will talk to NASA Earth scientists, as well as conduct and receive training in GLOBE science protocols at NASA's Goddard Space Flight Center in Greenbelt, Md., to take back into their classrooms across the world.

Reeling in students globally with in-the-field scientific measurements, GLOBE could harness an interest in science and turn it into a passion.

"Students learn to investigate scientific questions like actual scientists so, using specific protocols that allow them to compare data through time and across physical geography around the world," Foletta said. "It leads them to wonder about what they observe, which leads to questions and investigations generated by students themselves that mimic the way scientists tackle outstanding scientific problems."

She believes students who observe and understand their environment learn to value it and strive to preserve it.

During Foletta's tenure at Kingsburg, she crossed paths with a student in an advanced-placement biology class, Leigh-Ann Olsen. Olsen was a high school junior when she began participating in GLOBE.

Foletta remembers Olsen as being "talented" and a "go-to" person during many different projects. "She had a good background in many areas of science and knew more geology and astronomy than the others," Foletta said.

Foletta recalls being involved in two partnerships with NASA. Olsen participated in both. One in particular was about air quality in the valley surrounding their hometown. This became Olsen's focus as a GLOBE student.

"Leigh-Ann was the epitome of a GLOBE star student," Foletta said. "Who better to become a GLOBE star teacher?"

Nearly two decades after first working with GLOBE, Foletta has moved her things out of her Kingsburg science classroom, and Olsen is moving in. The student has now become the teacher.

"It was always in the back of my mind that I wanted to do this at some point in my career," said Olsen, who now has a degree in biology. "This last year, I had the opportunity to apply for the biology position opened due to Peggy's retirement, and I took it."

Taking the position just made sense to Olsen. "Peggy really stretched my brain, and got me out in the field," she said. "Getting me out into the world, doing real science, taking data and analyzing it helped to cement it all for me."

Olsen hopes many of her future students will feel the same way. As for her teaching goals, Olsen wants to awaken their understanding of science. "I want them to know that science isn't only about reading a book or working in a lab," Olsen said. "There are so many other things to become involved in, and GLOBE is a great gateway to those opportunities."

As for Foletta, she isn't saying farewell to GLOBE just yet. She currently serves as coordinator of the Central San Joaquin Valley GLOBE Partnership and as a highly ranked GLOBE trainer. She has served at more than 50 training events around the United States and in Germany. Foletta is also on the GLOBE Education Committee. ■

Above: Olsen (center) participates in a 2008 GLOBE workshop as Foletta's student teacher. Photo provided by Peggy Foletta

FROM GLOBE STAR STUDENT TO GLOBE STAR TEACHER

By: Crystal Garner

2013 SERVICE-DISABLED VETERAN-OWNED SMALL BUSINESS CONFERENCE

On August 13, 2013, NASA's Goddard Space Flight Center hosted the 2013 Service-Disabled Veteran-Owned Small Business Conference. The Industry Assistance Office within the Procurement Operations Division at NASA Goddard hosted the conference.

This year's conference was designed to provide small businesses with a series of networking and matchmaking sessions to help increase the knowledge base of how to successfully do business with NASA. Along with the sessions, the conference included a half-day of speakers and a business networking forum with prime contractors, small business specialists and NASA technical and business representatives.

Speakers included John Shoraka, Associate Administrator, Government Contracting and Business Development with the Small Business Administration, and deputy center director Rick Obenschain.

Matchmaking sessions featured representatives from the Office of Human Capital Management, the Office of Communications, the Flight Projects Directorate, the Applied Engineering and Technology Directorate, the Sciences and Exploration Directorate, the Information Technology and Communications Directorate, the Management Operations Directorate, Safety and Mission Assurance, and the Suborbital and Special Orbital Projects Directorate.

Approximately 400 attendees from small businesses, federal organizations, and prime contractors were at the conference. ■

Photo credit: NASA/Goddard/Debora McCallum

By: Elizabeth M. Jarrell

THE SCIENCE OF PHOTOGRAPHY

Imaging technology relies less on art than on engineering and science. Photographer Pat Izzo has the unique combination of a specialized science and engineering background coupled with an artistic eye that allows him to work with scientists and engineers at NASA's Goddard Space Flight Center in Greenbelt, Md., to create the images they want. Izzo is retiring in the middle of August.

"I have some artistic talent," Izzo said. "But at my core I am an imaging technologist, a photo scientist."

A graduate of the Rochester Institute of Technology with a degree in imaging technology, Izzo concentrated on the science behind photography, especially the chemistry and physics. One of his specialties is sensitometry, the science of tone reproduction, which involves dissecting the various tones of an image, converting each tone into a number and then manipulating the numbers to understand the picture from a scientific point of view.

"When you're looking at an image, that's a qualitative understanding, a visual impression," Izzo said. "We change the image from a visual to a numerical representation. That's sensitometry."

Another of Izzo's specialties is photo lab production technology, which involves applying the science of photography to the mass production of images. The technique is the same when using a photochemical process in a lab or an electronic process on a computer.

His third and favorite specialty is high-speed photography, which is based on high-speed motion analysis using physics and engineering. When mechanical devices operating at speeds much faster than the eye can see are having difficulties, the engineers and scientists call Izzo.

"I can take a million pictures per second," Izzo said. "It's pretty awesome stuff! At Goddard, we typically work at 1,000–2,000 pictures per second."

In high-speed motion analysis, Izzo photographs the device in motion using digital video technology to slow down the action to slow motion to reveal the source of the problems. Using specialized software, he tracks and measures the movement between consecutive images. That movement is then translated into numbers. Scientists can then use those numbers to determine velocity, acceleration, displacement, power, force and kinetic energy. Izzo's imagery for the fifth space shuttle flight in 1982 contributed to determining the in-orbit separation of the communications satellites deployed on the mission.

"It's time expansion," Izzo said. "We take very brief intervals of time, magnify time and slow down the action using high-speed equipment called motion analyzers."

Izzo is also known for his high-end photo shoots. "When I do a photo shoot, I try to see the vision in the client's head, and then transfer that image using cameras and lights, plus all the science and engineering, to an image that everyone else can see," he said. "I plan what I need to do to fulfill the client's dream, to make the client's image."

He will go all out—or in—to see what his client sees, once even putting on hip waders for a dip out to the middle of the Goddard pond for a shot. On a high-end photo shoot, he spends about eight hours planning, including possibly a pre-shoot photo session, and about four to six hours shooting. Planning is far more important than shooting, because once he formulates his plan, he just follows it.

Planning comes naturally to Izzo. He is internationally certified by the Project Management Institute as a project management professional and spent his early years as a project manager. While at Goddard, he led a project management study group in which many of the participants passed the PMP exam and earned the same coveted certification.

Moving forward, Izzo will return to project management and his first love, teaching. From 1983–1985, he taught photo lab production technology at the RIT. At one time or another, during 1996–2008, he taught every photography class offered by Prince George's Community College including their premier course in forensic photography for forensic technicians. He also hopes to return to Goddard next spring as part of the Office of Communications' StoryLab lecture series to give a presentation on "Project Management Through a Lens," which will focus on the science and management of high-speed motion projects. ■

Center: Just another day on the job for Pat Izzo. Photo credit: NASA/Goddard/Bill Hrybyk